

NOTE: This amendment
contains TSO-C50b

ADVANCE COPY: Pending
reissuance of Part 37
containing all TSO's

Title 14—AERONAUTICS AND SPACE

Chapter I—Federal Aviation Agency

SUBCHAPTER C—AIRCRAFT

[Docket No. 6797; Amdt. 37-7]

PART 37—TECHNICAL STANDARD ORDER AUTHORIZATIONS

Aircraft Audio and Interphone Amplifiers—TSO—C50b

The purpose of this amendment is to revise the Technical Standard Order (TSO) for aircraft audio and interphone amplifiers contained in § 37.149 of the Federal Aviation Regulations. This action was published as a notice of proposed rule making (30 F.R. 9319, July 27, 1965) and circulated as Notice No. 65-16 dated July 20, 1965. The notice was amended to extend the comment period in 30 F.R. 13786, October 29, 1965.

Notice 65-16 proposed to amend the performance standards of TSO-C50a by incorporating new environmental test procedures and by revising the requirement concerning the emission of spurious radio frequency energy. The notice also proposed an interphone amplifier bypass switch and added new categories for the various environmental parameters.

The parenthetical reference "for air carrier aircraft" and the phrase "to be used on U.S. civil aircraft engaged in air carrier operations" have been deleted from the title and applicability statement, respectively, of the final regulation. Such statements have created some confusion and they serve no useful purpose insofar as the TSO is concerned. As the preamble to Notice 65-16 clearly indicated, the TSO contains those standards that a manufacturer must meet in order to identify his equipment with the applicable TSO marking. A manufacturer desiring to use the applicable TSO marking must meet the prescribed standard regardless of the type of operation or the type of aircraft in which the equipment might be used. Moreover, from an operational standpoint, the Technical Standard Order system merely provides one means by which equipment is approved. Unless the operating rules re-

quire equipment to be TSO-approved, an operator may use any approved equipment. Therefore, reference to the type of operations in which aircraft audio and interphone amplifiers might be used has not been incorporated into the revised TSO.

The notice of proposed rule making on this matter incorporated by reference the requirements of the Federal Aviation Agency document entitled "Environmental Test Procedures for Airborne Electronic Equipment" dated August 31, 1962. Subsequent to Notice 65-16, the environmental test procedure document was set forth in TSO-C87, effective February 1, 1966 (30 F.R. 15553, Dec. 17, 1965), and it is this latter reference that now forms a part of TSO-C50b. Appropriate sections of the TSO have been amended to give the correct citation.

Several commentators recommended deletion or amendment of section 1.4 of the proposed standard that would have required inclusion of a normal emergency switch. It was their position that the switch is unnecessary because operators have available several alternate methods of preventing loss of signals, each more suitable than the switch, and the adequacy of any such method would normally be evaluated in the course of installation approval. For this reason, and because of the reliability and versatility of the newer audio and interphone systems employing solid state electronics, the Agency agrees that a normal emergency switch is unnecessary. Section 1.4 of the proposed standard, requiring a normal emergency switch, has, therefore, been deleted.

Section 1.4 of the notice, referencing a bypass function, prompted two commentators to suggest clarification as to which specific amplifiers the TSO is applicable. While the comments become moot by deleting section 1.4 of the proposed standard from the final rule, it is to be pointed out that the TSO standards are broad enough to cover any type of audio or interphone amplifier, including those providing switching or isolation functions, that an applicant may desire to qualify for a TSO authorization.

One manufacturer recommended that the audio frequency response, section 2.1 of the standard, be changed to allow only

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a 3 db variation in place of the 6 db proposed in the notice. However, even though an improved (flatter) response may be achieved from a design standpoint, service experience has shown that the present requirement provides the necessary minimum performance standard.

One comment recommended that the term "rated power output" as used in the sections relating to "distortion" and "audio noise level-without signal" and the various sections relating to standards under environmental test conditions, be changed to "rated distortion-free power output." While the new term appears to have some merit, the term "rated power output" has been current in the aviation industry for many years. From the Agency's point of view, the use of the recommended term would result in a substantive change in the proposal, the full effects of which are not known at this time. Therefore, the Agency considers that this recommendation warrants further study prior to its incorporation into the standard.

Pointing out that the best audio amplifier performance results from constant voltage where output power varies with output impedance, another commentator recommended that section 2.5 of the standard on output regulation be clarified. Since the intent of section 2.5 of the standard is that output voltage remain reasonably constant with variation in output impedance, the Agency agrees with the commentator and the section is changed to make clear that it is the voltage level that is to be kept within the stated limits.

The attenuator adjustment limitation of 10 db in section 2.6 of the proposed standard and Appendix A was originally imposed to insure crew ability to decode aurally the A-N signals associated with the four course ranges. Inasmuch as all such range facilities within the contiguous 48 States will be decommissioned in the near future, the Agency agrees with several commentators that the 10 db limitation is no longer a valid requirement. Sections 2.6, entitled Attenuator as proposed in the standard and in Appendix A have been deleted.

Apparently reading the sections on emission of spurious radiofrequency energy as requiring environmental tests even where a design does not generate RF energy, one commentator recommended in such cases that manufacturers be allowed to submit other proof of compliance with section 2.7 of the standard. Since it was not the intent that manufacturers be required to conduct tests that would serve no purpose, the commentator's point is well taken. Appendix A is amended to make it clear that testing for spurious radiofrequency energy in accordance with FAA Environmental Test Procedures is required only for designs that generate and emit such energy.

Speaking to the audiofrequency response measurement procedure, section 2.1b of Appendix A, one manufacturer recommended that the input signal used for checking the performance of the amplifier be applied through a 6 db pad rather than directly to the input of the

amplifier as stated in the notice. While the test procedures set forth in sections 2.1 through 2.7 of Appendix A provide acceptable means for determining the performance of audio and interphone amplifiers, section 2.0 also permits the use of test procedures that provide equivalent information. Therefore, the proposed regulation permits the manufacturer to use his method for checking the performance of the amplifier if it provides equivalent information to that provided by section 2.1b of Appendix A.

Another comment relating to section 2.1b, Appendix A, suggested that setting the level control, where provided, to produce maximum output as required by the notice, would discourage a manufacturer from providing spare gain to compensate for aging transistors or other circuit components. The Agency believes that this is a valid point and concurs in the desirability of providing spare gain. The measurement procedures for all the Appendix A test procedures have therefore been amended to allow the level control to be set to produce rated amplifier output instead of maximum amplifier output.

Other minor changes of an editorial or clarifying nature have been made. They are not substantive and do not impose any additional burden on regulated persons.

Interested persons have been afforded the opportunity to participate in the making of this amendment. All relevant material submitted has been fully considered.

(Secs. 313(a), 601, Federal Aviation Act of 1958 (49 U.S.C. 1354, 1421))

In consideration of the foregoing and pursuant to the authority delegated to me by the Administrator (25 F.R. 6489), § 37.149 of Part 37 of the Federal Aviation Regulations is amended as hereinafter set forth below effective August 18, 1966.

Issued in Washington, D.C., on July 13, 1966.

JAMES F. RUDOLPH,
Acting Director,
Flight Standards Service.

§ 37.149 Aircraft audio and interphone amplifiers—TSO-C50b.

(a) *Applicability.* This technical standard order prescribes the minimum performance standards that aircraft audio and interphone amplifiers must meet in order to be identified with the applicable TSO marking. New models of the equipment that are to be so identified, and that are manufactured on or after the effective date of this section, must meet the requirements of the "Federal Aviation Agency Standard, Aircraft Audio and Interphone Amplifiers" set forth at the end of this section and the "Federal Aviation Agency Document for Environmental Test Procedures for Airborne Electronic Equipment" set forth in TSO-C87, effective February 1, 1966 (30 F.R. 15553, Dec. 17, 1965).

(b) *Marking.* (1) In addition to the markings specified in § 37.7, the equipment must be marked to indicate the environmental extremes over which it has been designed to operate. There are six environmental procedures outlined in the FAA Document for Environ-

mental Test Procedures for Airborne Electronic Equipment that have categories established. These must be identified on the nameplate by the words "Environmental Categories" or, as abbreviated, "Env. Cat." followed by six letters that identify the categories designated. Reading from left to right, the category designations must appear on the nameplate in the following order so that they may be readily identified—

- (i) Temperature-altitude category;
- (ii) Vibration category;
- (iii) Audio-frequency magnetic field susceptibility category;
- (iv) Radio - frequency susceptibility category;
- (v) Emission of spurious radiofrequency energy category; and
- (vi) Explosion category.

(2) A typical nameplate identification is: Env. Cat. DBAAAX.

(3) If a manufacturer desires to substantiate his equipment under two categories, he must mark the nameplate with both categories in the space designated for that category by placing one letter above the other in the following manner: Env. Cat. ABAAAX

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(c) *Data requirements.* In accordance with § 37.5, the manufacturer must furnish to the Chief, Engineering and Manufacturing Branch, Flight Standards Division, Federal Aviation Agency, in the region in which the manufacturer is located, the following technical data:

(1) Manufacturer's operating instruction and equipment limitations.

(2) Installation procedures with applicable schematic drawings, wiring diagrams, and specifications. Indicate any limitations, restrictions, or other conditions pertinent to installation.

(3) Manufacturer's test report.

(d) *Previously approved equipment.* Aircraft audio and interphone amplifier models approved prior to August 18, 1966, may continue to be manufactured under the provisions of their original approval.

FEDERAL AVIATION AGENCY STANDARD AIRCRAFT AUDIO AND INTERPHONE AMPLIFIERS

1.0 GENERAL STANDARDS

1.1 *Rating of Components.* The equipment must incorporate in its design components of such rating that, when the equipment is operated throughout the range of the specified environmental tests, the ratings established by the manufacturers of the components are not exceeded. For electron tubes, the continuous commercial service rating of the tube manufacturer is applicable except for the heaters and filaments. The voltage applied to the heaters and filaments of electron tubes must be within 5 percent of the manufacturer's rating when the equipment is operated under standard test conditions.

1.2 *Operation of Controls.* The design of the equipment must be such that the controls intended for use during flight cannot be operated in any possible position combination or sequence that would result in a condition whose presence or continuation would be detrimental to the continued performance of the equipment.

1.3 *Effect of Tests.* Unless otherwise stated, the design of the equipment must be such that the application of the specified tests produces no discernible condition that would be detrimental to the reliability of equipment manufactured in accordance with such design.

2.0 MINIMUM PERFORMANCE STANDARDS UNDER STANDARD TEST CONDITIONS

The electrical test procedures applicable to a determination of the performance of the equipment under standard test conditions are set forth in Appendix A of this standard.

2.1 *Audiofrequency Response.* The audio output must not vary more than 6 db when the level of an audio input signal is held constant and the frequency varied over the frequency range of 350-3,000 c.p.s.

NOTE: The response of the audio amplifier may be changed to effect an overall aircraft receiving system response including the receiver, headphones, etc., such that the audio output does not vary more than 6 db when the level and the percentage modulation is held constant and the audiofrequency varied over the range of 350 to 2,500 c.p.s.

2.2 *Distortion.* The combined noise and distortion in the output of the amplifier must not exceed (a) 20 percent at rated power output, (b) 6 percent at 0.01 of rated power output. This standard must be met over the frequency range of 350-3,000 c.p.s.

2.3 *Coupling Between Audio Circuits.* The coupling between the audio input circuits of the amplifier must be down at least 40 db at all position combinations of the audio selector switches.

2.4 *Audio Noise Level—Without Signal.* The level of the noise output of the amplifier, in the absence of an audio input signal, must be at least 40 db below the rated output of the amplifier. Equipment designed for an a.c. power source must meet this requirement at all power frequencies within the range for which the equipment is designed.

2.5 *Output Regulation.* The change in the voltage level of the output signal must not exceed 3 db and the distortion in the output signal must not exceed 25 percent, when the output load impedance is changed from that for which the amplifier is designed to 50 percent and to 200 percent of that for which the amplifier is designed.

2.6 *Emission of Spurious Radiofrequency Energy.* The levels of conducted and radiated spurious radiofrequency energy emitted by the equipment must not exceed those levels specified in Appendix A to Federal Aviation Agency Document for Environmental Test Procedures for Airborne Electronic Equipment set forth in TSO-C87 (30 F.R. 15553, December 17, 1965), hereafter referred to as FAA Environmental Test Procedures.

3.0 MINIMUM PERFORMANCE STANDARDS UNDER ENVIRONMENTAL TEST CONDITIONS

Unless otherwise specified, the test procedures, applicable to a determination of the performance of this equipment under environmental test conditions are set forth in the FAA Environmental Test Procedures. The applicable electrical test procedures are set forth in Appendix A of this standard.

3.1 *Temperature—Altitude Test.* a. Low Temperature Test—When subjected to this test, the manufacturer's rated power output must be obtained and the requirements of paragraphs 2.2 and 2.4 must be met.

b. High Temperature Test—
(1) When the equipment is operated at the high shorttime operating temperature:

(a) The power output must not be more than 6.0 db below the manufacturer's rated output.

(b) All mechanical devices must operate satisfactorily.

(c) There must be no evidence of materials, such as grease or potting and sealing compounds, exuding or dripping from the equipment components.

(2) When the equipment is operated at the high operating temperature, the manufacturer's rated power output must be obtained and the requirements of paragraphs 2.2 and 2.4 must be met.

c. Decompression Test (Applicable Only to Category D Equipment of Temperature-Altitude Test)—When the equipment is subjected to this test, the power output must not be more than 3.0 db below the manufacturer's rated output.

d. Altitude Test—When the equipment is subjected to this test, the manufacturer's rated power output must be obtained and the standards of paragraph 2.2 must be met.

3.2 *Humidity Test.* After subjecting to this test, and:

a. Immediately following the 15-minute warmup period, the power output must not be more than 3.0 db below the manufacturer's rated output.

b. Within 4 hours from the time primary power is applied, the manufacturer's rated power output must be obtained.

3.3 *Shock Test.* a. Following the application of the operational shocks, the manufacturer's rated power output must be obtained.

b. Following the application of the crash safety shocks, the equipment must have remained in its mounting, and no part of the equipment or its mounting must have become detached and free of the table or of the equipment.

NOTE: The application of these tests may result in damage to the equipment under test. Therefore, these tests may be conducted after the other tests are completed.

3.4 *Vibration Test.* When subjected to the vibration test, the manufacturer's rated power output must be obtained and the standards of paragraph 2.4 must be met.

3.5 *Temperature Variation Test.* When the equipment is subjected to this test, the manufacturer's rated power output must be obtained.

3.6 *Power Input Test.* When subjected to this test, the manufacturer's rated power output must be obtained and the requirements of paragraphs 2.2 and 2.4 must be met.

3.7 *Low Voltage Test.* a. When the primary power voltage(s) of d.c. operated equipment is 80 percent and when that of a.c. operated equipment is 87½ percent of standard test voltage(s), the standards of paragraph 2.2 must be met.

b. Direct current operated equipment must operate satisfactorily within 2 minutes upon returning the primary voltage(s) to normal after the gradual reduction of the primary power voltage(s) from 80 percent to 50 percent of standard test voltage(s).

c. The gradual reduction of the primary power voltage(s) of d.c. operated equipment from 50 percent to 0 percent of standard test voltage(s) must produce no evidence of fire or smoke.

NOTE: The application of these tests may result in damage to the equipment under test. Therefore, these tests may be conducted after the other tests are completed.

3.8 *Conducted Voltage Transient Tests.*

a. Following the intermittent transient test, the manufacturer's rated power output must be obtained.

b. During the repetitive transient test, the standards of paragraph 2.4 must be met.

3.9 *Conducted Audiofrequency Susceptibility Test.* When the equipment is subjected to this test, the standards of paragraph 2.4 must be met.

3.10 *Audiofrequency Magnetic Field Susceptibility Test.* When the equipment is subjected to this test, the standards of paragraph 2.4 must be met.

3.11 *Radiofrequency Susceptibility Test (Radiated and Conducted).* When subjected to the conducted radiofrequency susceptibility test, the standards of paragraph 2.4 must be met.

NOTE: In the case of amplifiers designed for use with power source filters external to the amplifier, filters having characteristics for which the equipment is designed may be used to meet this requirement.

3.12 *Explosion Test (When Required).* During the application of this test, the equipment must not cause detonation of the explosive mixture, within the test chambers.

APPENDIX A

1.0 TEST CONDITIONS

The following definitions of terms and conditions of test are applicable to the equipment tests specified herein:

a. *Power Input Voltage—Direct Current.* Unless otherwise specified, when the equipment is designed for operation from a direct current power source, all measurements must be conducted with the power input voltage adjusted to 13.75 V, ± 2 percent for 12-14 V equipment, or to 27.5 V, ± 2 percent for 24-28 V equipment. The input voltage must be measured at the equipment power input terminals.

b. *Power Input Voltage—Alternating Current.* Unless otherwise specified, when the equipment is designed for operation from an alternating current power source, all tests must be conducted with the power input voltage adjusted to design voltage ± 2 percent. In the case of equipment designed for operation from a power source of essentially constant frequency (e.g., 400 c.p.s.), the input frequency must be adjusted to design frequency ± 2 percent. In the case of equipment designed for operation from a power source of variable frequency (e.g., 350 to 1,000 c.p.s.), tests must be conducted with the input frequency adjusted to within 5 percent of a selected frequency within the range for which the equipment is designed.

c. *Adjustment of Equipment.* The circuits of the equipment must be properly adjusted in accordance with the manufacturer's recommended practices prior to the application of the specified tests.

d. *Test Instrument Precautions.* Due precautions must be taken to prevent the introduction of errors resulting from the connection of headphones, voltmeters, oscilloscopes, and other test instruments across the input and output impedances of the equipment during the conduct of the tests.

e. *Ambient Conditions.* Unless otherwise specified, all tests must be conducted under conditions of ambient room temperature, pressure, and humidity. However, the room temperature must not be lower than 10° C.

f. *Warmup Period.* Unless otherwise specified, all tests must be conducted after a warmup period of not less than 15 minutes.

g. *Connected Loads.* Unless otherwise specified, all tests must be conducted with the equipment outputs connected to loads having the impedance value for which the equipment is designed.

2.0 TEST PROCEDURES

The following test procedures are satisfactory for use in determining the performance of aircraft audio and interphone amplifiers. Test procedures that provide equivalent information may be used.

2.1 *Audiofrequency Response—A. Equipment Required.* Audio Oscillator (Hewlett-Packard Model 205-A or equivalent) Output Power Meter (General Radio Model 583-A or equivalent).

b. *Measurement Procedure.* If the amplifier has a level control, set it to produce rated amplifier output. Apply a 1,000 c.p.s. signal to the amplifier input. Adjust the input signal level to produce 10 percent of rated output. Maintain the input signal level constant and vary the frequency of the audio signal through the range of 350 to 3,000 c.p.s. and determine the maximum and minimum amplifier output level.

2.2 *Distortion—A. Equipment Required.* Audio Oscillator (Hewlett-Packard Model 205-A or equivalent) Output Power Meter (General Radio Model 584-A or equivalent) Distortion and Noise Meter (RCA Model 69-B or equivalent).

b. *Measurement Procedure.* If the amplifier has a level control, set it to produce rated amplifier output, then—

(1) Apply a 1,000 c.p.s. signal to the amplifier input. Adjust the input signal level to produce rated output. Maintain the input signal level at the value producing rated output at 1,000 c.p.s. and determine the percentage distortion plus noise in the amplifier output signal at input signal frequencies of 350, 500, 1,000 and 3,000 c.p.s.; and

(2) Repeat procedure in paragraph (1) with an input signal level that produces 0.01 of rated output at 1,000 c.p.s.

2.3 *Coupling Between Audio Circuits—*
a. *Equipment Required.* Audio Oscillator (Hewlett-Packard Model 205-A or equivalent) Distortion and Noise Meter (RCA Model 69-B or equivalent).

b. *Measurement Procedure.* If the amplifier has a level control, set it to produce rated amplifier output. Apply to one of the amplifier input circuits a 1,000 c.p.s. signal and adjust its level to produce rated output from the amplifier. Determine the output in db above or below the 1,000 c.p.s. input signal level, at the terminals of the other input circuits of the amplifier for all

possible ON-OFF combinations of the audio selector switches and level control settings of the amplifier.

2.4 *Audio Noise Level—Without Signal—*
a. *Equipment Required.* Distortion and Noise Meter (RCA Model 69-B or equivalent).

b. *Measurement Procedure.* Apply to the terminals of the amplifier input circuits, resistors having a value equal to the impedance for which the input circuits are designed. If the amplifier has a level control, set it to produce rated amplifier output. Determine the maximum amplifier output for all possible ON-OFF position combinations of the audio selector switches. When the equipment is designed for operation from an a.c. power source, determine the maximum amplifier output over the input power source frequency range for which the equipment is designed for all possible ON-OFF position combinations of the audio selector switches.

2.5 *Output Regulation—*a. *Equipment Required.* Audio Oscillator (Hewlett-Packard Model 205-A or equivalent) Output Power Meter (General Radio Model 583-A or equivalent) Distortion and Noise Meter (RCA Model 69-B or equivalent).

b. *Measurement Procedure.* If the amplifier has a level control, set it to produce rated amplifier output. Apply to the amplifier input a 1,000 c.p.s. signal and adjust its level to produce 10 percent of rated output from the amplifier. Determine the amplifier output and the distortion plus noise in the output signal with output load impedances of 50 percent, 100 percent, and 200 percent of that for which the amplifier is designed. Repeat the above procedure for audio signals of 350, 500, 1,800, and 3,000 c.p.s.

2.6 *Emission of Spurious Radiofrequency Energy.* Testing need only be done on amplifier equipment that is of such a design that it will generate and emit spurious radio-frequency energy.

a. *Equipment Required.* Comply with paragraphs 2.0 a. and b. of Appendix A of FAA Environmental Test Procedures.

b. *Measurement Procedure.* Comply with paragraph 2.0c. of Appendix A of FAA Environmental Test Procedures.